5.0 ROOF ELEMENTS ARTICLES

NOTES

5.1.0 INTRODUCTION

The roof of any building is essential to the protection of its structure. It must be protected and maintained.

The roof is also an important character defining element of historic buildings. The roof shape and pitch, the overhangs and raftertails, the gable end detailing, roofing materials, fascia and roofing accessories such as cresting, downspout leader heads, cupolas and gable end vents are all significant elements of the building's identity. They should be identified, retained and preserved.

A roof consists of its deck, framing, means of removing water and its roofing materials.

Most roofing materials on the historic buildings at Fort Lewis are cement or clay tile. Buildings 4076, 4175 and 2022 have metal roofing. The metal and tile roofs are discussed in a separate study and therefore are not included here.

This section, therefore, is general in nature and discusses only composition roofing and the occasional use of copper roofing materials.

The roof deck in historic buildings usually consists of either tongue and groove boards, shiplap sheathing or nailing strips. Some plywood will be found where repairs have been done. Tongue and groove boards were used for low sloped roofing or roofing exposed on the underside such as porch roofs. Nailing strips were used across rafters to provide a means of nailing the shingles. They were spaced several inches apart and thus allowed the roof to breathe. Plywood decking and/or composition roofing do not allow the roof to breathe and therefore can trap condensation in the roof framing if the attic is not vented.

The roof framing gives the roof its shape, supports the deck and roofing material, and should always be sloped to drain water. Roof framing of historic buildings can usually be seen from the attic space. Sizes of rafters can vary from much larger than is common today to much smaller than needed to support several layers of reroofing.

The roof framing and decking can both be damaged if leaks occur or if water is not allowed to drain freely away. Clogged gutters allow water to back up into framing and decking, thus causing decay. Cracked gutters allow water to seep into rafter ends or soffits. Improper flashing allows water to damage decking, framing and eventually the walls below.

Composition roofing at historic sites is often seen as a replacement for original wood roofing. At Fort Lewis, composition roofing is present at the Hostess House, the cobblestone gas station, the small storehouse 4074, the museum and at an infill between two motor shops. Most of these roofs are in poor condition.

Composition roofing usually consists of a felt sheet saturated with asphalt flux and coated with small rock granules.

Asphalt is not a very stable material when exposed to the sun. It softens, hardens, shrinks and cracks. The small rock granules are applied to protect the asphalt, but they tend to collect soil, moisture and moss.

Composition roofing has a shorter life than most other roofing materials.

Composition roofing is laid in courses starting with a double layer at the bottom and nailed to the decking. A 16 oz. copper or 26 gauge galvanized drip edge should be installed around the edges of the decking before the roofing material is applied.

Copper roofing materials endure the sun's rays, thermal expansion and contraction, and the presence of moisture. Copper is a low maintenance material.

Its incidental use at Fort Lewis includes siding at Barracks dormers, sheets at arched porch roofs at NCO housing, standing seam porch roofs and roofing of sun porches at Broadmoor housing, gabled porch roofs at officer's housing, arched dormer roofs at Building 1010, standing seam roofing at the side entry to Building 4174 and at various areas of the Chapel.

Copper sheet used as flashing or roofing should be at least 16 ounce.

Copper roofing should be placed over a solid deck covered with building paper. Sections must be soldered if the slope is less than 3 inches per foot. Otherwise they may be joined with an interlocking folded seam in which anchorage cleats are placed. Seams may be "flat", "standing" or "batten" and should always be formed per SMACNA recommendations.

Always separate copper from wood with rosin building paper.

5.1.1 TYPICAL REPAIRS

5.1.1.1 GENERAL

All repairs and reroofing should be done in accordance with the National Roofing Contractors' Association standards by qualified subcontractors experienced with historic buildings. **The NRCA Roofing and Waterproofing Manual** contains flashing details, roofing and reroofing instructions and explanatory articles.

Do not reroof over three or more layers of previous roofing. Old roofing must be completely removed first. Repair structure first if framing is weak, sagging, or buckling.

Repair or replace any unsound decking.

Replace cracked or damaged flashing with new flashing as soon as possible. Application of temporary asphalt or tar to flashing often weakens it, reroutes water to more vulnerable areas, or defaces adjacent building materials.

Do not use asphalt shingles which attempt to imitate wood or other materials, or are brightly colored.

5.1.1.2 Roof is leaking.

CAUSE
Deteriorated flashing or deteriorated roofing.

REPAIR
Where this is occurring at Fort Lewis, both the roofing and flashing probably need complete replacement.

5.1.1.3 Flashing is cracked.

CAUSE
Fatigue or stress.

REPAIR
Replace with copper sheet of same gauge, 16 ounce minimum.
Secure with copper rivets if large sheet, or copper clips and tabs held with copper nails or brass screws for smaller pieces.
Verify that deck is solid and covered with building paper.
Do not make temporary repairs which will cause stress at other locations or which will divert water. Duct tape may be used for temporary repairs.

5.1.1.4 Copper is soiled, streaked or unevenly discolored.

CAUSE
Uneven weathering.

REPAIR
Cleaning should not be done unless soil is severe.
Cleaning should be done only by a specialist in the treatment of copper. The condition of the copper should be examined at the same time.
Cleaning compounds include rottenstone and oil, whiting and ammonia, chalk and ammonia, and for thick crusts, sodium hexametaphosphate and water, sulfuric acid and water, or oxalic acid with pumice and water.
Specifications for copper cleaning should require compliance with standards of the Copper Development Association.
If a fresh copper color is desired, it may be lacquered with three coats of clear lacquer or "Incralac".

5.1.2 MAINTENANCE RECOMMENDATIONS

A. Anything which can hold moisture against the roofing material should be removed promptly. This includes tree leaves, needles, and moss. Check and remove twice a year.

B. Gutters which are clogged or can't hold all runoff water need to be cleaned immediately to prevent backup into decking or framing.

C. Clean gutters twice yearly, more frequently if adjacent to large trees.

D. Do not use abrasives on copper. Use prepared copper cleaner.

5.1.3 COMMENTS

Roofing work should be done by roofing subcontractors who have been approved by the manufacturers of the products they are installing.

The work should be inspected by qualified personnel during installation.

Specifications for contracted work must require proof of experience with historic buildings and historic roofing materials, and compliance with SMACNA Standards, NRCA Standards and Copper Development Association Standards.

TILE ROOFS 5.2

5.2.0 GENERAL

The tile roofs at Fort Lewis are historically significant and should be preserved and maintained.

For maintenance, repair and other information on tile roofs refer to the "Fort Lewis Tile Roof Study, 1987".

NOTES

METAL ROOFS 5.3

5.3.0 GENERAL

The metal roofing used at Fort Lewis is historically significant and should be preserved and maintained.

For maintenance, repair and other information on metal roofs refer to the previous article, 5.1 Roofing, and the "Fort Lewis Tile Roof Study, 1987, Supplement".

NOTES

FLASHING 5.4

5.4.0 INTRODUCTION

Flashing provides moisture protection at joints between building materials, areas where moisture may be trapped in wood, and on exposed flat surfaces where ponding moisture may deteriorate building fabric.

The purpose of flashing is to direct moisture to an area where it will not affect the building fabric. Consequently, placement of flashing should consider overall drainage patterns of the building. Flashing should be installed following details such as those shown in **Architectural Graphics Standards** and **National Roofing Contractors Association Manual.**

Although some flashing was provided with the original design of the structures at Fort Lewis, it is lacking in some areas, particularly in association with roof repairs and replacement. In a limited number of instances, existing flashing was poorly installed and is contributing to deterioration.

New flashing in areas where no original flashing existed should be installed in a manner that is not conspicuous.

Flashing generally occurs at vent stacks, roof drip edges, parapets, dormers, roof valleys, slope breaks, porch roof abutments.

Although caulks and sealants may be used as a finishing aid, they never should substitute as a primary weatherproofing. Sound metal flashing materials should be properly installed to maximize weatherproofing.

5.4.1 TYPICAL REPAIRS

5.4.1.1 GENERAL

Repair generally requires replacement of deteriorated flashing materials. Particular attention should be paid to proper flashing details during reroofing. This will substantially reduce future maintenance problems. Substandard original flashing details should be corrected at this time.

Although flashing leaks may be temporarily stopped by application of plastic asphalt cement, duct tape or latex roof coating, this should always be considered a stop-gap measure to stem immediate moisture problems and allow proper planning for flashing replacement.

Use 16-gauge cold-rolled copper, 26-gauge galvanized sheet steel, or tern-coated stainless steel for major flashing. Do not use rolled composition roofing as flashing. Use only copper, hot-dipped galvanized, or stainless steel nails and fasteners. Fasteners should be compatible with flashing materials to eliminate possible galvanic action.

When the rake of a roof abuts a vertical wall (such as at parapets, dormers, or porches) the most satisfactory method is to use stepped metal flashing applied over the end of each course of roofing. Strips should extend at least 2 inches onto the roof underlayment and 4 inches vertically. Flashing on tile roofs should be bent to form a trough that curls up under the hollow tile.

Intersections with masonry should include anchoring counterflashing in mortar joints. Joints should be raked-out to a depth of 1.5 inches, flashing inserted, and the joint refilled with mortar. Do not nail flashing materials to masonry.

Flashing should be backed by heavy-weight rosin-sized sheathing paper; use of bituminous felt under metal flashing can cause adhesion and buckling.

5.4.1.2 Cracks or buckling of flashing materials.

CAUSE
Metal fatigue (particularly at bends), metal gauge too thin, improper fastening or restriction of metal expansion.

REPAIR
Remove entire length of affected metal and replace.
If only a section is removed, match replacement material with existing to prevent galvanic reactions.

5.4.1.3 Metal crumbling, powdering, pitting, or corroding.

CAUSE
Galvanic action corrosion, atmospheric chemical decomposition, particulate corrosion.

REPAIR
Remove and replace either entire run of flashing or deteriorated segment.
If only a segment is replaced, it is important to match new materials to original to prevent galvanic deterioration.

5.4.1.4 Moisture damage, stains, or fungus evident on eaves and soffits.

CAUSE
Improperly installed or corroded drip-flashing (generally in conjunction with deteriorated or poorly maintained gutters).

REPAIR
Inspect flashing in area of moisture damage.
Rebend to direct water into gutter if metal is sound.
Replace if deteriorated.
It may be helpful to run water onto roof to assist in identifying problem area.

5.4.2 MAINTENANCE RECOMMENDATIONS

A. Inspect all flashings for corrosion or other deterioration during fall gutter cleanout. Distress includes metal fatigue cracks, buckling, powdering or crumbling, or pitting and corrosion (see below).

B. All flashing areas, particularly roof valleys, should be cleaned of debris during annual gutter maintenance. Moisture-trapping debris will hasten spot corrosion.

ATTIC VENTILATORS 5.5

5.5.0 INTRODUCTION

Attic ventilation at Fort Lewis consists of a combination of end-gable louvers, dormer louvers, metal ventilator stacks, wood cupolas, and some more recently installed prefabricated attic vent units.

Attic ventilation is not evident on many Fort Lewis buildings and additional investigation is needed to confirm adequate ventilation.

Attic ventilation is necessary to reduce moisture build-up and associated deterioration of building materials in enclosed unheated spaces adjacent to heated spaces.

Attic ventilation also assists in reducing thermal buildup and summer cooling loads.

5.5.1 TYPICAL REPAIRS

5.5.1.1 Broken, split, or deteriorating wood end gable or cupola louver vents.

CAUSE

Mechanical damage; weathering or rot resulting from inadequate maintenance.

REPAIR

Evaluate condition of vent.

If damage is minor, repair or replacement of individual louver slats is preferable.

If entire vent is deteriorated it may be necessary to replicate original vent.

Do not use standard metal vents to replace those that are part of the original building fabric.

Remove vent carefully.

For repairable vents, disassemble and, if paint layers are excessive, strip to bare wood using a water-soluble and non-flammable chemical paint remover.

Replace damaged elements, reassemble, and repaint.

Bare wood should receive an initial application of 2 or 3 brush-on coats of a 50:50 mixture of boiled linseed oil and paint thinner, followed by an alkyd primer and 2 coats of either latex or oil based paint.

If seriously deteriorated, use the original vent as a pattern for constructing a replacement.

5.5.1.2 Deterioration of attic building materials when roof system is weathertight.

CAUSE

Attic ventilation is inadequate or does not provide flow-through capabilities.

REPAIR

Evaluate ratio of attic ventilation area to attic floor area.

For standard end-gable only vents there should be at least 1 square foot of vent area for every 300 square feet of floor space.

For cupola/ridge ventilator stack and soffit ventilator system, the exhaust area should be at least 1:1600 and the intake (soffit or end-gable louver) vents 1:900.

Where ventilation is inadequate, install additional screened vent openings.

New vents should be located in areas where they are not easily visible or in a manner that reduces visual impact to the historic character of the building.

Multiple small soffit vents coupled with ridge vents are preferable to larger end vents.

Vents on rear gable elevations are preferable to installation on the main facade.

New vents in visible areas should be painted to match surrounding fabric so that they do not stand out.

In limited cases, vents similar to historic designs used on other buildings may be replicated and used on buildings lacking ventilation.

5.5.1.3 Rusting tinned or galvanized ridge vent.

CAUSE

Deterioration of the plating to the point that the underlying steel is exposed and rusting.

REPAIR

Remove rust scale by gentle brushing with non-ferrous wire brush.

Apply a rust removal product such as naval jelly only in the affected area following manufacturers instructions.

Prime unpainted surfaces with a coat of linseed oil and paint with an acrylic resin.

5.5.2 MAINTENANCE RECOMMENDATIONS

A. Inspect louvers and vents every two years to make sure they are not obstructed or deteriorating.

B. Keep all surfaces primed and painted. The only exception is uncorroded galvanized sheet metal rooftop ventilator portions that are not exposed to direct weathering.

5.5.3 COMMENTS

A number of metal ventilator stacks are not painted on interior surfaces. While not immediately critical, they are less likely to corrode over the long-term if the interior portions are painted as part of an overall upgrading and maintenance program.

The large metal roof ventilators and cupolas are part of the historic fabric and character of Fort Lewis. Most appear to be in serviceable condition and should require only basic maintenance and repair. If, however, severe deterioration occurs, they should be replicated as a specialty item conforming to the original design. Most experienced sheet metal fabricating shops should be able to duplicate the large vent stacks, and cupolas are standard frame construction. In no case should they be eliminated and the roof area patched over. They perform an important function in maintaining the buildings and are major character defining elements of the historic district.

Some of the large ventilator stacks are still hooked into an internal air circulation system, which has been blocked or not maintained and is not serving a useful purpose. In evaluating attic ventilation, consideration should be given to disconnecting the internal system (particularly in light of planned rehabilitation) and using the stacks for attic ventilation exclusively.

NOTES

GUTTERS AND DOWNSPOUTS 5.6

5.6.0 INTRODUCTION

Fort Lewis has a variety of gutters and downspouts ranging from scupper systems with fluted copper downspouts to simple half-round units with round downspouts.

Many of the Fort Lewis gutter and downspout systems within the historic district have been replaced in recent years and are in generally good condition. Some anchors, however, have not been adequately fastened to masonry surfaces.

Replacement gutters should match the existing style; modern gutters of PVC or those with a generally rectangular section are not appropriate at Fort Lewis.

A number of buildings have decorative cast iron downspout boots. These are important historic elements of the building design. Decorative varieties are specialty items that require casting at an iron foundry.

Improperly functioning gutters result in rotting roof structure, stained or deteriorating brick and mortar, and moisture problems at foundation level.

5.6.1 TYPICAL REPAIRS

5.6.1.1 GENERAL

Half-round metal replacement gutters should be hung with permanent heavy duty support brackets under the gutters rather than the usual top hangers and gutter spikes.

Replacement gutters should be sized to accommodate the potential water flow contributed by the roof area. Some of the existing replacement gutters are far too small.

83

Downspouts should be made with shop fabricated and soldered joints and offsets rather than pre-fab sectional construction with slip joints.

For buildings of this size, cleanout access fittings should be installed at the junction of each downspout with the storm sewer line.

5.6.1.2 Water pouring over lip of gutter.

CAUSE

Plugged downspouts, improperly sized gutter or downspout, loose hangers, deteriorated roof structure.

REPAIR

Clean plugged downspouts.

If problem persists, check gutter attachments and hanging points for deterioration.

Reconstruct damaged materials; damage to eaves may be repaired by splicing-in sound replacement wood.

If weight of water has bent the existing gutter it should be replaced.

5.6.1.3 Peeling paint on eaves; stains, vegetation, deteriorated mortar, or moisture on adjacent wall.

CAUSE
Plugged downspouts, corroded and leaking gutter metal or eave trough sheeting.

REPAIR
Clean plugged downspouts.
Inspect gutter for holes; replace or rebuild deteriorated sections.

5.6.1.4 Plugged downspout.

CAUSE
Debris plugging downspout or damage to downspout from vehicles and equipment.

REPAIR

If debris block, remove a lower segment of downspout and flush-out.
Do not allow clog to be forced into a sewer or drainfield system.
Replace all vehicle damaged segments that restrict flow.

5.6.1.5 Rust stains on or adjacent to downspouts, particularly at joints and offsets.

CAUSE
Pinholes and corroding metal.

REPAIR
Replace damaged segments.
If possible, entire downspout system should be replaced using soldered-joint fabrication.

5.6.1.6 Staining on copper gutters or downspouts.

CAUSE
Galvanic reaction caused by iron or steel hangers and anchors.

REPAIR
Install non-metallic separation pads such as thin plastic strips in contact area.

5.6.1.7 Loose anchors in masonry walls.

CAUSE
Mortar deterioration, mechanical damage, or corroded anchorbolts.

REPAIR
Regrout anchor bolts; new bolts should be used to make repair last longer.

5.6.1.8 Rusting decorative downspout boots.

CAUSE
Broken seal or plugged system causing overflow and moisture conditions on surface of boot.

REPAIR
Scrape all blisters showing in painted surface.

Remove heavy scale and rust with a wire brush attached to an electric drill or hand clean with putty knife, wire brush, or emery cloth.
Naval jelly may be used to reduce rust pockets when rusting is severe; rinse all surfaces thoroughly with water.
In some cases, items can be removed for more extensive stripping and chemical treatment using an acidic pickling bath and phosphate dipping in a shop setting.

Prime all cleaned surfaces **immediately** and repaint. Use rust retarding enamel paints such as Rust-O-leum or Derusto.

5.6.2 MAINTENANCE RECOMMENDATIONS

A. Clean gutters of debris twice a year (spring and fall). Remove large debris by hand prior to flushing gutters with water.

B. Check for adequate slope and drainage towards downspouts during cleaning.

C. Make sure that all downspout connections have wire strainers and that they are properly installed. Strainers will block large debris and leaves that result in downspout and sewer clogging.

D. Inspect annually for deterioration of adjacent roofing and soffit areas, flashing, and hangers. Look for peeling paint or stains on wood trim at cornices and eaves, loose boards or evident rust stains, stains or vegetation on wall surfaces below gutters and downspout connections, eroded mortar joints, and interior water stains on walls and ceilings near gutter locations.

E. Isolate and repair any identified problems as quickly as possible. The inner face of gutters may be coated with a brush-applied waterproof bituminous paint as a temporary measure. Do not, however, use bituminous products in an attempt to correct drainage slope problems. This not only reduces the gutter's carrying capacity, it also delays repair of a more serious problem of poor attachments or deteriorating eaves.

NOTES

CHIMNEYS 5.7

5.7.0 INTRODUCTION

Brick chimneys and tops are important character elements on the historic buildings at Fort Lewis. If chimneys are unsound they may be a safety hazard.

An important part of most of the chimneys is the decorative or corbelled top or concrete caps.

Rebuilding of historic chimneys is preferred over removal or replacement with metal.

Historic brick is often softer and more porous than those manufactured today with less overall quality control and consistency between units.

Historic brick is likely to have differences in hardening between the surface and the interior (body) of the brick. The hardness of the exterior surface provides the moisture-resistant properties.

5.7.1 REPOINTING

Repointing is necessary when the mortar holding the brickwork together is eroded by weathering or decomposed to the point that it is easily scored or removed by a screwdriver.

Mortar used in repointing should always be softer than the adjacent brick.

Mortars with high Portland cement content should not be used.

Historic mortar traditionally was a lime-based mortar mixture of lime, sand, and water. These mortars develop very low compressive strengths, take a long time to harden, and have poor durability to the freeze-thaw cycle.

Low compressive strength mortar is most suitable to the softer more porous nature of historic brick. Serious damage may occur to historic brick by using high-strength portland cement based mortars. Mortar used in repointing historic masonry must always be softer than the surrounding brick to prevent breaking-up the existing materials

5.7.2 BRICK REPLACEMENT

Bricks require replacement if they are seriously deteriorated, are cracked from building movement, vehicular damage, or previous attempts at repair or repointing, or if programmatic requirements require infilling of openings.

Replacement brick should match existing brick as closely as possible. This brick may be salvaged from demolished structures, relocated from an area where removal has a minimal effect on the historic character of the building, or obtained from manufacturers that carry reproduction specialty brick.

Relocated brick should be analyzed to ensure durability. Poorer brick was sometimes used for interior walls and may not withstand exterior use.

5.7.3 FLASHING

Chimney bases should be reflashed when roofing material is replaced.

The flashing provides a weather seal where the roof and roofing material meet the brick.

Some chimneys may have only limited flashing. Full flashing should be installed when replacement repairs are made.

Flashing may be painted to reduce the visual prominence.

Use 16-gauge cold-rolled copper, 26-gauge galvanized sheet steel, or tern-coated stainless steel for major flashing.

Do not use rolled composition roofing as flashing.

Use only copper, hot-dipped galvanized, or stainless steel nails and fasteners.

Fasteners should be compatible with flashing materials to eliminate possible galvanic action.

5.7.4 CHIMNEY CAPS

Many chimneys at Fort LewisBarracks have mortar caps. These originally served two purposes: 1) to assist in directing the hot gases into the air; and 2) to channel water off the top of the chimney.

Cap mortar should be analyzed before replacing severely cracked and deteriorated caps.

Use mortar that matches the original in composition and hardness.

Reproduce the original configuration of the cap. In some cases caps are substantial enough to form part of the decorative aspects of the chimney.

5.7.5 TYPICAL REPAIRS

5.7.5.1 Spalled, cracked, or otherwise damaged brick.

Water damage to interior finishes or structure not caused by poor mortar joints.

CAUSE

Moisture damage from weak or poorly fired brick; moisture damage from heavy paint buildup; improper use of Portland cement mortar.

REPAIR

Work must be done by a skilled mason.
Remove brick by hand chiseling. Ensure that adjacent sound brick is not damaged.
Use replacement bricks that are close match to original brick in color, texture, size, and hardness.
Soak new brick in neutral pH water before laying.
Feather new brick into existing sound masonry
Match new mortar joints to original.

5.7.5.2 Porous outer surface of brick.

CAUSE
Poor quality brick or damage from sandblast cleaning.

REPAIR
Structural engineer should evaluate overall integrity of building.
Replace brick as above if only a small area is affected.
Use of sealants is not recommended except in cases of severe deterioration.
If absolutely necessary and on the advice of a preservation architect, seal surface using a solvent-based sealer manufactured specifically for historic preservation application.

5.7.5.3 Mortar eroded or weathered from original joint levels. Mortar soft and easily loosened by prodding with a screwdriver.

CAUSE
Deterioration of mortar bond; weathering from wind, rain, and particulates.

REPAIR
Remove weathered mortar to a minimum depth of 3/4 inches from surface.
Hand chiseling is the preferred method although a few experienced contractors are capable of power techniques for horizontal joint areas.
If the latter method is specified, contract specifications should require proof of experience in dealing with certified historic preservation projects.

Use a high lime mortar mix. ASTM Type K mortar with no more than 1 part Portland cement to 4 parts lime may be used to increase strength and workability if brick-strength analysis indicates that the resulting mix is softer than the brick.

Use sand conforming to ASTM C-144 that matches grain size from original mortar.

Use clean, potable, neutral pH water.

Match color of historic mortar as closely as possible using natural materials (sand color, pulverized brick, etc.) or if necessary mortar pigments.
Always test color by either wetting original or allowing a test sample to dry before repointing.

Repointing joints should reproduce the original joint.

5.7.5.4 Flashing deterioration including metal fatigue, powdering or crumbling, or pitting and corrosion.

CAUSE

Galvanic action corrosion, atmospheric chemical decomposition, particulate corrosion, improper bending of sheet metal.

REPAIR

Remove unit and replace with new flashing.

If serious condition occurs but roofing materials are sound, new flashing may be installed by removing a limited number of shingles to set flashing.

It is recommended that a small supply of roofing materials be kept in supply after a reroofing job to eliminate mismatched shingles in flashing or other roof repair.

For chimneys under 30 inches wide, a bent flashing and counterflashing mortared into the chimney may be used on the uphill side; chimneys wider than 30 inches require a metal saddle or "cricket" on the uphill side.

If necessary, install a saddle even though one did not exist.

It is not a highly visible or intrusive element.

Base flashing should turn up a minimum of 3 inches around the entire base of the chimney.

Counterflashing should be mortared into the joints of the chimney at least 1-inch deep and lap over base flashing.

5.7.5.5 - Few or small cracks in chimney cap.

CAUSE

General deterioration due to freeze-thaw, moisture infiltration, weathering, or the residual effects of flue heat.

REPAIR

Patch in similar fashion to small concrete patch repairs.

Minor cracks including seasonal or hairline cracks may be filled with epoxy or drypacked depending on the severity of the crack.

Cracks treated in this manner must be stable.

Epoxy treatment is appropriate only when cracks are large enough to let the epoxy flow into them.

Cracks must be clean and dry.

Cut a trough at the top edges to permit effective flow.

Inject epoxy to the full depth of the crack to ensure bonding.

Drypack methods require chipping all unsound material to a depth of one inch.

Widen cracks by cutting and scraping and provide undercut interior edges to create a mechanical lock for the patch.

Clean area with water or compressed air, allow full drying, and prime with an acrylic latex bonding agent.

Pack the area with cement mortar that has similar characteristics (compressive strength and thermal expansion properties) as the original materials.

5.7.5.6 Major cracking or softening of the chimney cap mortar. Mortar is weak if it can be chipped or cracked with a screwdriver.

CAUSE

Severe weathering and decomposition of the brick caused by the combination of flue gases and moisture.

REPAIR

Carefully chip original cap off the chimney being careful to keep a record of the original configuration.

Mortar on a new cap at a minimum of two inches thick in the center following the design of the original chimney cap.

Overhang the edge of the top bricks slightly to provide a drip edge that reduces moisture on the brick surface.

5.7.6 CLEANING

Brick surfaces should be cleaned using the gentlest possible method to accomplish the job.

Make sure that all surfaces to be cleaned are in good condition including both bricks and mortar. If not, repair before cleaning and allow adequate time for compounds or mortar to harden.

Remove all plant-growth (lichens, mosses, ivy, etc) before major cleaning. Plant-growth should be removed using wood scrapers or non-ferrous brushes. Lichens can be killed with a solution of zinc or magnesium silica fluoride (one part to 40 part water).

Cover chimney flues to keep water out of the building.

Make sure that roof and flashings are in good condition and use protective sheeting (plywood or plastic).

Make sure that drainage is adequately channeled so that other building areas will not be affected. Do not let gutters overflow. If necessary, channel with temporary troughs.

Hand cleaning is more appropriate for chimneys.

Water soak surfaces to soften heavy dirt.

Use soft-bristle brush and mild detergent for all hand cleaning.

Start water cleaning procedures at the top of the area that is to be cleaned.

Perform a final rinse of fresh water if detergents have been used.

Do not use water cleaning methods during periods of cold, damp weather. Doing so will increase the chance for water penetration into materials and possible cause long-term damage.

Sometimes, especially after repointing or repair, a white or green chalky coating will appear on a brick surface. This efflorescence is caused by salts leaching out of bricks or mortar. Dry-brush using stiff natural or nylon bristle brushes. If necessary, continue brushing using a neutral pH water. If efflorescence is green, brush on a solution of sodium hydroxide (12 ounces per quart of water) and allow to dry as a white salt deposit. Wash with clean water 3 to 4 days later. Do not subject to hydrochloric (muriatic) acid cleaning.

5.7.7 MAINTENANCE RECOMMENDATIONS

A. Establish an exterior cleaning program on a cycle of 5 to 10 years. Clean flues annually if used.

B. Establish an inspection program to identify cracking, spalling, or deteriorating brick and decomposition or weathering of mortar. Inspections should occur on a 5 to 10 year schedule.

C. Inspect all flashings for corrosion or other deterioration during fall gutter cleanout. Distress includes metal fatigue cracks, powdering or crumbling, or pitting and corrosion.

D. All areas on the uphill side of the chimney should be cleaned of debris during annual gutter maintenance. Moisture-trapping debris will hasten spot corrosion.

E. Caps will not require general maintenance other than periodic cleaning of moss and other vegetation.

F. Caps should be inspected for cracking and deterioration at the same time as general inspection of brick and mortar conditions.